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(71) Applicant (*for all designated States except US*): F.L. SMIDTH & CO. A/S [DK/DK]; Vigerslev Alle 77, DK-2500 Valby (DK).

(72) Inventors; and
(75) Inventors/Applicants (*for US only*): SORENSEN, Peter [DK/DK]; Vigerslev Alle 77, DK-2500 Valby (DK). FONS, Mogens, Juhl [DK/DK]; Amollevej 26, DK-9560 Hadsund (DK).

(74) Agent: GILL JENNINGS & EVERY; Broadgate House, 7 Eldon Street, London EC2M 7LH (GB).

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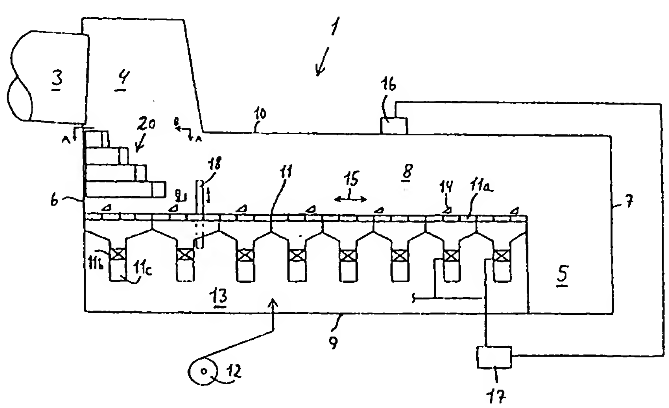
(54) Title: COOLER FOR COOLING OF PARTICULATE MATERIAL



(57) Abstract

A cooler (1) is disclosed for cooling particulate material which has been heat-treated in an industrial kiln such as a rotary kiln (3) for manufacturing cement clinker. The cooler has an inlet end (4), an outlet end (5), end walls (6, 7), side walls (8), a bottom (9) and a ceiling (10). At least one supporting surface (11) for supporting the material to be cooled is provided, as well as means (11a, 12) for injecting cooling gas into the material, and means (14) for conveying the material forward across the supporting surface from the inlet end (4) to the outlet end (5). An inlet section (20) is fitted in the inlet end for receiving the material from the kiln and for distributing this material on the supporting surface. The inlet section means (20) distributes the material which is received from the kiln across the cooler in directions towards the side walls of the cooler. Thus it is possible to extend the width of the cooler without having to extend the inlet section correspondingly, due to the fact that the material can be distributed in a better and more uniform manner also in the width direction of the cooler. The wear rate of the moving parts is reduced because the velocity of the conveying means can be reduced and, furthermore, a better heat exchange between the clinker and the cooling gas in the inlet zone is achieved because the thickness of the protective layer of the stationary clinker on the inlet surface can be better adapted.

COOLER FOR COOLING OF PARTICULATE MATERIAL

The present invention relates to a cooler for cooling particulate material which has been heat-treated in an industrial kiln, such as a rotary kiln for manufacturing cement clinker. Such coolers may comprise an inlet end, an outlet end, end walls, side walls, a bottom and a ceiling, at least one supporting surface for supporting the material which is to be cooled, means for injecting cooling gas into the material, and means for conveying the material forward across the supporting surface from the inlet end to the outlet end. An inlet section is fitted in the inlet end for receiving the material from the kiln and for distributing this material on the supporting surface.

Several coolers of this kind are known from the literature. These traditional coolers typically incorporate an inlet section with a fixed so-called "idealized two-dimensional inlet surface", by which is meant that the horizontal generatrices of the inlet surface which extend crosswise of the longitudinal direction of the cooler are parallel and extend over the full width of the cooler inlet. The material, which falls into the cooler from the kiln, is spread on the inlet surface in such a traditional cooler in an approximately parabolic shape, having an apex at the point of impact. The wall lining in the inlet section of such a cooler is therefore typically configured for compatibility with this physical shape. Furthermore, the inlet section is typically formed with an angle of inclination which is less than the natural angle of slide of the clinker, so that during operation a protective layer of stationary clinker is formed on the inlet surface. If, for a given production target, the width of the cooler is extended in order to lower the speed required to operate the means of conveyance and hence to reduce the wear exposure of the moving parts, the consequence thereof is that the length of the inlet section must be increased proportionately in order to ensure a satisfactory transverse distribution of the material in the inlet section. If the length of the inlet section is made too long, the result will be too great a thickness of the protective layer of stationary clinker, and, in actual practice, this will have a negative effect on the heat exchange between the clinker and the cooling gas in this zone. This means that the temperature of the cooling gas which is subsequently utilized as combustion air in the kiln is too low, while the clinker being conveyed on the subsequent supporting surface is not cooled sufficiently, thus potentially increasing the thermal loading to which the supporting surface is subjected.

The present invention is aimed to provide a cooler whereby the aforementioned disadvantages are eliminated.

According to the present invention therefore, a cooler of the kind mentioned in the introduction, is characterized in that it comprises, in the inlet section, means for distributing the material which is received from the kiln across the cooler in direction towards the side walls of the cooler.

Thus it is possible to extend the width of the cooler without having to extend the inlet section correspondingly due to the fact that the material can be distributed in a better and more uniform manner also in the width direction of the cooler. As a consequence hereof, the wear rate of the moving parts can be reduced because the velocity of the conveying means can be reduced and, furthermore, the thickness of the protective layer of the stationary clinker on the inlet surface can be better adapted for achieving optimum heat exchange between the clinker and the cooling gas in this zone.

The means of distribution may be formed in any one of a number of possible ways in order to meet the necessary prerequisite of the material being distributed also in the width direction of the cooler. However, it is preferred that such means comprise an idealized three-dimensional inlet surface, i.e. a surface which comprises horizontal generatrices or horizontal tangents which are present in at least two different directions, mutually intersecting one another. As non-limiting examples hereof can be mentioned a vertical section of a pyramid or a truncated pyramid the imaginary or undivided base of which consisting of a polygon with an arbitrary number of sides, and a vertical section of a cone or a truncated cone.

For achieving the optimum and most uniform distribution of the material in the inlet section it is suggested according to the present invention that the inlet surface be displaceable reciprocably in the crosswise direction of the cooler. Alternatively, the areas immediately ahead of the inlet surface may be provided with adjustable means to achieve a local reduction of the conveying efficiency so that the material will tend to flow towards those areas of the supporting surface of the cooler where the highest degree of conveying efficiency occurs. The conveying efficiency reduction means may consist of transverse plates or girders being displaceable in upward and downward directions, substantially through the supporting surface.

To prevent formation of so-called snowmen on the inlet surface, the latter may be of a stepped design and so configured that at least one step can be moved independently of the other steps in a direction which is not parallel to any of the sides of the inlet surface which are of paramount importance in terms of functionality.

The cooler may be of the kind which is described in PCT/EP98/02012 the contents of which being hereby considered as being part of the present application. In this known cooler the conveying means consist of a reciprocating scraper system which comprises a number of rows of scraper elements extending across the direction of movement of the material, said elements reciprocating in the direction of movement of the material in order to carry the material forward across the supporting surface.

Two examples of coolers according to the invention will now be described in further details with reference to the accompanying diagrammatic drawings, in which:-

Fig. 1 shows a side view of a first cooler according to the invention,

Fig. 2 shows a sectional view A-A of the cooler shown in Fig. 1 viewed from above,

Fig. 3 shows a sectional view B-B of the cooler shown in Fig. 1 viewed from the outlet end of the cooler, and

Fig. 4 shows a sectional view corresponding to that in Fig. 2 of a second.

In Fig. 1 is seen a cooler 1 which is installed in extension of a rotary kiln 3 for manufacturing cement clinker. The cooler comprises an inlet 4, an outlet 5, end walls 6, 7, side walls 8, a bottom 9 and a ceiling 10. The cooler also comprises a stationary grate bottom 11 which is made up of a number of grate plates 11a for supporting the cement clinker, a fan 12 for injecting cooling gas up through the clinker via a chamber 13 and the grate bottom 11, and a row of scraper elements 14 which by means of a driving mechanism not shown can be made to reciprocate in the longitudinal direction of the cooler as indicated by the double arrow 15, so that the clinker is carried from the inlet end of the cooler to its outlet end. The cooler may be configured with several juxtapositioned rows of scraper elements 14.

The cooler shown also comprises continuously and automatically operating flow regulators 11b which are installed in the gas supply duct 11c of each grate plate 11a for regulating the cooling gas flow up through the single grate plate. Measuring and monitoring equipment 16 is connected via a controller 17 with each flow regulator. A flow control system of this kind is described in PCT/EP96/02971, the contents of which being hereby considered as being part of the present application.

The cooler also comprises, in the inlet section, means 20 for distributing the material which is received from the kiln 3, crosswise of the cooler in the direction towards the side walls 8 of the cooler. The distribution means 20 substantially consists of an idealized three-dimensional inlet surface 20 and, as is best seen from Figs. 2 and 3, the

latter may consist of a stepped pyramid 20. The pyramid 20 is shown with four steps, but in practice it may comprise fewer or more steps. The entire pyramid can be displaced backwards and forwards i.e. reciprocably in the transverse direction of the cooler as indicated by the double arrow 21, and at least one of the steps may be movable independently of the others as indicated by the double arrow 22.

As alternatives, the inlet surface 20 may be constructed basically configured as a part-conical surface or truncated cone.

In the area immediately ahead of the inlet surface the cooler shown comprises barrier means in the form of transverse plates 18 each of which extends over a part of the cooler width, and is displaceable up and through the supporting surface. The plates 18 are used to achieve a local reduction of the conveying efficiency whereby the material will tend to flow towards the areas of the supporting surface of the cooler where the conveying efficiency is greatest.

In Fig. 4 can be seen, in plan view, an example of an alternative embodiment of the pyramid-like shaped inlet surface 20.

CLAIMS

1. A cooler (1) for cooling particulate material which has been heat-treated in an industrial kiln such as a rotary kiln (3) for manufacturing cement clinker, which cooler comprises an inlet end (4), an outlet end (5), end walls (6, 7), side walls (8), a bottom (9) and a ceiling (10), at least one supporting surface (11) for supporting the material to be cooled, means (11a, 12) for injecting cooling gas into the material, and means (14) for conveying the material forward across the supporting surface from the inlet end to the outlet end and which includes an inlet section disposed in the inlet end for receiving the material from the kiln and for distributing this material on the supporting surface, **characterized in** that the inlet section comprises means (20) for distributing the material received from the kiln across the cooler in directions towards the side walls of the cooler.

2. A cooler according to claim 1, **characterized in** that the distribution means (20) comprises an idealized three-dimensional inlet surface.

3. A cooler according to claim 1 or claim 2, **characterized in** that the distribution means (20) comprises a vertical section of a pyramid or a truncated pyramid, the imaginary or undivided base of which consisting of a polygon.

4. A cooler according to claim 2, **characterized in** that the distribution means (20) comprises a vertical section of a cone or a truncated cone.

5. A cooler according to any of claims 2 to 4, **characterized in** that the distribution means (20) can be displaced backwards and forward in the crosswise direction of the cooler.

6. A cooler according to any of claims 2 to 4, **characterized in** that adjustable barrier means (18) are provided in the area immediately ahead of the distribution means (20) to achieve a local reduction of the conveying efficiency.

7. A cooler according to claim 6, **characterized in** that the barrier means (18) consist of transverse plates or girders which can be displaced upwards and downwards, substantially through the supporting surface.

8. A cooler according to any of claims 2 to 7, **characterized in** that the distribution means (20) is of a stepped design and so configured that at least one step can be moved independently of the others in a direction non-parallel to any of the sides of the distribution means which are of paramount importance in terms of functionality.

9. A cooler according to any of the preceding claims, **characterized in** that the conveying means (14) consists of a reciprocating scraper system which comprises a number of rows of scraper elements extending across the direction of movement of the material, said elements reciprocating in the direction of movement of the material in order to convey the material forward across the supporting surface.

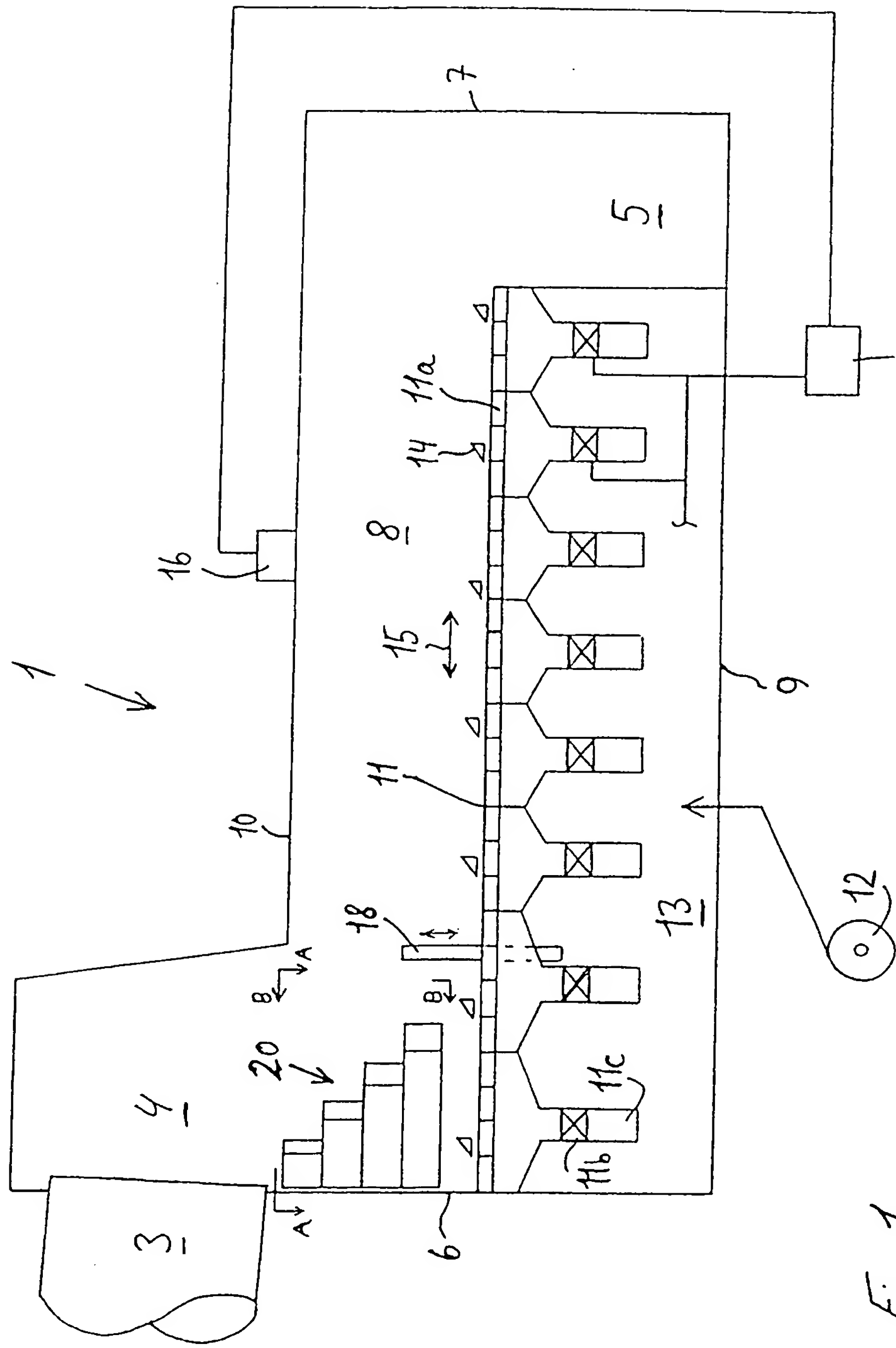
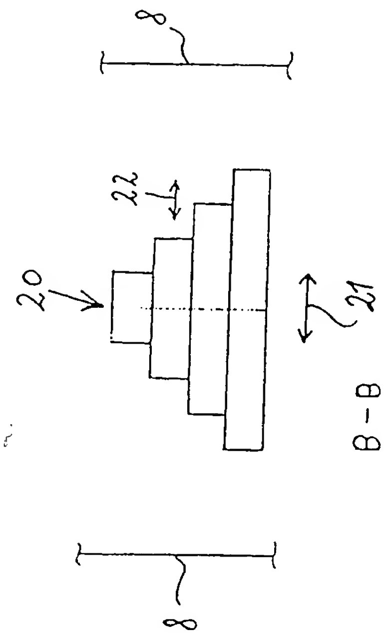
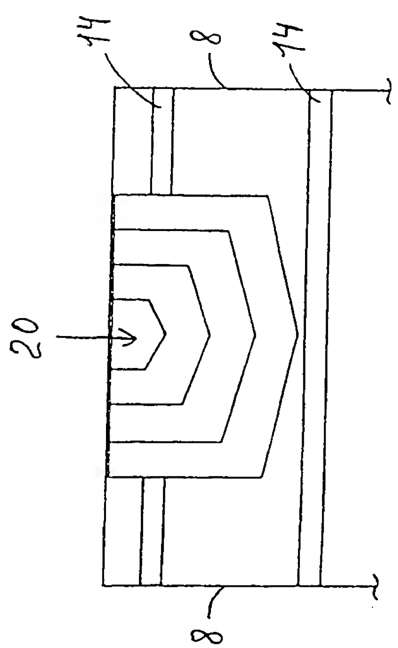


Fig. 1



B – B

Fig. 3



A – A

Fig. 2

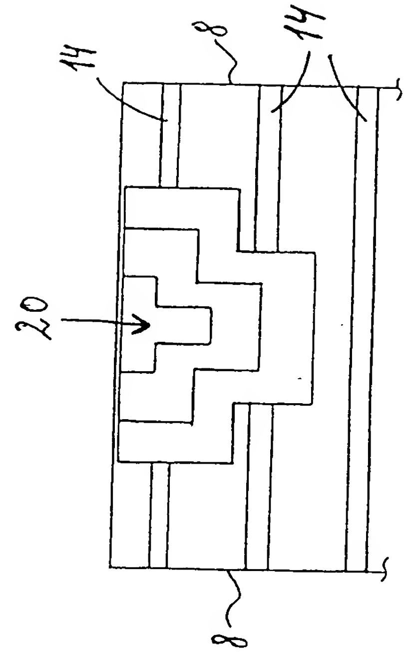


Fig. 4

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/EP 99/09066

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F27D3/00 F28C3/16 F27D15/02 B65G69/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F27D F28C B65G F27B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	DE 24 52 753 B (WALTHER & CIE) 29 April 1976 (1976-04-29) claims; figures ---	1,3
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 February 2000	02/03/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Coulomb, J

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INTERNATIONAL SEARCH REPORT

Inter. onal Application No
PCT/EP 99/09066

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 99/09066

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